DOCUMENT RESUME

ED 258 182 CS 208 878

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TITLE Effects of Genre-Specific Setting on Causal Chain Comprehension.
PUB DATE 84
NOTE 27p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Cognitive Processes; *Literary Devices; *Literature Appreciation; *Reading Comprehension; *Science Fiction
IDENTIFIERS *Literary Settings

ABSTRACT

A study was conducted to investigate the relationship between understanding the setting and understanding the causal chain of a science fiction story. The 72 subjects, ranging in age from 16 to 54 and in educational level from high school seniors to those holding the doctoral degree, were divided into two groups that were labeled as sophisticated or naive science-fiction readers, according to their scores on the Science Fiction Knowledge Test. Additional materials used in evaluating the two groups were an adapted version of Marta Randall's story "Secret Rider," the 16-item Causal Chain Test, and the 35-item Setting Test. The materials were completed in one untimed sitting that took between 75 and 90 minutes. The setting summary was randomly presented with the story to 16 naive readers and 17 sophisticated readers. Findings showed that sophisticated subjects recalled significantly more setting and causal chain information than naive subjects. Furthermore, although understanding of the causal chain was not completely dependent on the understanding of the setting, there was a significant relationship between causal chain and setting. (DF)

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EFFECTS OF GENRE-SPECIFIC SETTING ON CAUSAL CHAIN COMPREHENSION

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Fordham University, 1984

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The investigator hypothesized that the macro-structure SETTING enhances Causal Chain comprehension. Because Setting information interacts with prior knowledge about most stories' universes, a science fiction story was chosen. Since science fiction Settings do not correspond to reality, information cannot routinely be applied by default. The investigator hypothesized that Sophisticated science fiction readers, using a genre-specific schema, would understand more Setting information, and therefore more story events, than would Naive readers, using a general story schema. Subjects were competent adult readers, classified by prior knowledge of science fiction. Dependents were tested in a multiple-choice recall condition. Sophisticated subjects recalled significantly more Setting and Causal Chain information than Naive subjects. There was a significant relationship between Causal Chain and Setting test scores. The investigator concluded that Sophisticated readers had an advantage in recalling Causal Chain and Setting information.

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INTRODUCTION

Schema theory research has focused upon simple stories (Kintsch, 1977; Mandler & Johnson, 1977; Rumelhart, 1975, 1977; Stein & Glenn, 1979; Thorndyke, 1975). Nevertheless, it is assumed that schema theory will help to account for comprehension of more complex text. Although the literature speculates about schemata for encoding text other than simple stories, little has been done to discover how mature readers comprehend fiction which is longer, more complicated, or of a different genre than simple stories.

The major impetus for the present study was the researcher's question about the lack of prominence that the macro-structure (Kintsch, 1974) SETTING had been given in research done with stories simple enough for their stereotypical and familiar Settings to be constructed as a default value by readers. Rumelhart (1975) and Thorndyke (1975) regarded SETTING as contributing little to the processing of such stories, although other researchers (Kintsch & Kozminsky, 1977; Mandler & Johnson, 1977) acknowledged a greater function for SETTING in story comprehension. The present author investigated the comprehension of a story whose reality assumptions could only be constructed during its reading--a science fiction story--and the ways in which science fiction Settings differ from Settings in realistic fiction were described. The comprehension of readers who were familiar with science fiction was compared to the comprehension of those with little experience reading science fiction. Comprehension was measured in terms of recall of Setting information and of the Causal Chain--i.e., the path of causally connected events (Trabasso, Secco, & van den Broek, in press)--of a science fiction story.

BACKGROUND

Requisite Components of Stories

For text to be a story, requisite components of simple stories must be present. A story must involve a character in a sequence of episodes (Thorndyke, 1975), each episode consisting of an exposition, a complication, and a resolution (Kintsch, 1977). Such a story can be represented by a causal chain (Warren, Nicholas, & Trabasso, 1979). However, the temporal and causal chain need not mirror the order of a simple story grammar to be processed as a story (Kintsch, Mandel, & Kozminsky, 1977; Thorndyke, 1975; Winograd, 1977). To be a story, a narrative must have a Theme (Thorndyke, 1975). However, the intentions and motivations need not be those of a human or animal protagonist (Wymer, Calderonello, Leland, Steen, & Evers, 1978).

A story must also have a Setting. In simple stories, Setting information provides instructions to use frame (van Dijk, 1977) information provided by a known possible-world fragment (van Dijk, 1977). The macro-structure SETTING is treated almost as a constant by story grammars (e.g., Rumelhart, 1975; 1977; Thorndyke, 1975). SETTING usually consists of a sentence(s) containing stative propositions which establish the story's context by setting up the story's global constraints, including a time context, a location context, and reality assumptions (Thorndyke, 1975). Thorndyke appeared to regard

any such SETTING information as contributing equally to processing. Rumelhart (1975; 1977), who defined SETTING as a structure into which the remainder of the story can be linked, stated that SETTING plays no integral part in the body of the simple story, and that in brief, stereotyped stories, SETTING can be eliminated.

What has not been thoroughly investigated is the interaction between the semantic information carried by text propositions which fill the SETTING slots of the schema and the remaining schema macro-structures. But frame knowledge of the possible-world to which a text refers determines if text will be understood (van Dijk, 1977). Kintsch (1977) stated that the function of a good exposition is to establish a stable frame within which to view story events. Nevertheless, only Mandler and Johnson (1977), among cognitive researchers, have thus far stated that SETTING functions differently in different genres. SETTING may aid processing by calling up specialized schemata (Rumelhart & Ortony, 1977), thereby informing readers which default values may be assigned.

The Importance of SETTING

If complex stories induce readers to form and use schemata which differ from a simple story schema, information carried by the initial story substructures of various story genres may aid in the formation and activation of such schemata. Evidence suggests that SETTING is thus involved in story comprehension. When Kintsch and Kozminsky (1977) compared summaries people wrote about stories they had read with summaries they wrote for stories they heard, a significantly larger portion of subjects' summaries was devoted to the first quarter of each story than to the remaining quarters. Readers found Setting to be very important in a summary (Kintsch & Kozminsky, 1977). More recently, Pratt, Luszcz, MacKenzie-Keating and Manning (1982) experimentally manipulated the Setting information contained within a story, concluding that comprehension of Setting plays an essential role in making metacognitive judgments about stories.

When SETTING information confirms that frame knowledge of a familiar possible-world applies to a story, discovering whether information subsumed within the macro-structure SETTING induces the use of specific narrative schemata would be confounded, since it would be impossible to separate knowledge the reader applied as a result of familiarity with an appropriate possible-world from knowledge derived from the text. The role of SETTING might be more easily examined if it were possible to remove the redundancy that knowledge about such a possible-world fragment supplies.

Science Fiction as a Story Genre

Cognitive researchers regard science fiction stories as having the requisite components of stories (Thorndyke, 1975; van Dijk, 1977). Science fiction critic Bova (1974) stated that science fiction fulfills the requirements for telling a story--the creation of a character set in conflict. Similarly, Bretnor (1974) stated that science fiction "is governed by precisely the same literary and dramatic requirements as any other form of literature" (p. 15).

For the purposes of the present study, a definition of science fiction was required. Philmus (1976) stated that science fiction is distinguished from realistic fiction in that the ordinary incidents in the latter do not require scientific explanation, and that it is distinguished from fantasy in that extraordinary incidents in fantasy do not allow scientific explanation.

The Importance of SETTING in Science Fiction. Science fiction author and critic Samuel R. Delany (1977), presented extensive evidence that SETTING functions differently in science fiction than it does in other story genres, suggesting that a science fiction schema may uniquely specify the kinds of presuppositions that are inappropriate, thus instructing the Sophisticated reader to hold open default assignments and/or to make those default assignments specifically suggested by the science fiction schema.

If SETTING functions differently in science fiction than in other story genres, then readers who use SETTING information to choose a schema might be better able to anticipate, and use as cues for encoding, conventions characteristic of science fiction.

SETTING in Science Fiction. Science fiction is the one class of stories within this culture in which Setting information does not entail previously-known reality assumptions. Therefore, although SETTING does not typically influence either a character's goal or causally connected events (Grasser, Robertson, Lovelace, and Swinehart, 1980), a science fiction Setting may instruct the reader to search for the story's reality assumptions only within the text.

If science fiction schemata exist, specific cues must induce their formation and call up their use. Discourse conventions which are used characteristically or are characteristically violated within science fiction Settings might be cues which call up science fiction schemata.

One discourse convention separating science fiction from other story genres is the way default values are filled. Reading science fiction requires holding default values open until schema slots are cued by textual information (Delany, 1977; 1978). To read science fiction, one might use a schema more specialized than those described by Kintsch (1977), Rumelhart (1975, 1977), or Thorndyke (1975).

Science fiction Settings also differ from mundane fiction Settings in that ideas likely to be metaphorical in mundane fiction are often meant literally in science fiction stories (Delany, Note 1). An example is the sentence: "The door dilated" from Robert Heinlein's 1960 novel Beyond This Horizon (Delany, Note 1). Similarly, in science fiction, "Her world exploded" is likely to denote a physical event rather than emotional pain (Delany, Note 1). A science fiction schema might instruct the reader to process such potentially ambiguous sentences literally, while a general story schema may contain the expertation that such statements are metaphorical.

A specialized science fiction schema might involve assigning only those variables bound explicitly or implicitly by the text while holding other variables open. Thus, if a science fiction schema exists, it is generalized from a general story schema, but uniquely specialized in that it indicates what kind of

presuppositions cannot be made rather than instructing the reader to assign default values routinely. That troublesome constant which Rumelhart and Ortony (1977) speculated would be replaced by a variable in forming a more generalized schema may be SETTING in science fiction.

Expertise

Experts behave differently than do novices in problem solving (Chase & Simon, 1973), and in knowledge acquisition (Chiesi, Spilich, & Voss, 1979; Spilich, Vesonder, Chiesi, & Voss, 1979; Voss, Vesonder, & Spilich, 1980). Expertise involves the ability to recognize recurrent and characteristic patterns inherent in a situation (Bransford, Nitsch, & Franks, 1977).

Specific genres characteristically employ specific conventions (Delany, 1978; Kintsch, 1982; Mandler & Johnson, 1977; Winograd, 1977) whose significance may go unnoticed by a Naive reader employing a general schema. Such conventions may be anticipated and used by a Sophisticated reader employing a genre-specific schema.

Facilitating Reading Through the Use of Summary

Reder and Anderson (1979) pointed out that the purpose of including details in chapters of expository text is to familiarize students with the field's argument structure. But reading a summary is superior to reading a text which supplies both important points and their details (Reder & Anderson, 1979). A corollary question is whether reading a summary which provides generalizations implied by a text's details aids in comprehending those details. Science fiction, because of the lack of known-world redundancy, is a logical genre with which to explore such a question.

PURPOSES

The main purposes of the present study were to investigate how information subsumed within the macro-structure SETTING contributes to story comprehension, and to investigate whether readers who may be considered to be Sophisticated readers of science fiction are better able to use the Setting conventions within that genre than are Naive readers. An additional purpose was to investigate the effect of the preliminary reading of a summary of a science fiction story's Setting upon readers' story comprehension.

It was predicted that readers using a science fiction schema would comprehend science fiction stories more successfully than would readers using a more general story schema. Because of Delany's descriptions of science fiction, it was hypothesized that Sophisticated science fiction readers would be more likely to refrain from inappropriate presupposition, decide correctly when ordinary frame knowledge does apply, and correctly interpret both metaphorical language and literal language which would be intended metaphorically in mundane fiction.

DESIGN OF THE STUDY

Independent and Dependent Measures

Setting

A story's Setting: (a) introduces the main character(s), and (b) describes the social, physical, or temporal context in which the story occurs (Stein & Glenn, 1979). The second category of Setting information is further differentiated below.

Type of Imagery. Science fiction Setting information can be categorized according to the type of imagery used.

1. Literal-Consistent. A Setting proposition is literal-consistent if it is meant literally a science fiction story and would be meant literally in mundane, i.e., realistic, fiction. The following sentence contains literal-consistent Setting propositions:

> Always arriving the barest moment too late, always just behind the jet that left, the ship that sailed, the tauship that taued the day before, carrying him with it. (Randall, 1981, p. 1)

2. Metaphor-consistent. A Setting proposition is metaphor-consistent if it is meant metaphorically a science fiction story and would be meant metaphorically in mundane fiction. The following sentence contains a metaphor-consistent Setting proposition (underlined):

> She swam in the dark red waters of the inland sea and safaried across the endless plains that girdled the planet at the equator. (Randall, 1981, pp. 2-3)

3. Literal-inconsistent. A Setting proposition is literal-inconsistent if it is meant literally in a science fiction story but would be metaphorical in mundane fiction. The following sentence contains a literal-inconsistent Setting proposition:

> She had followed him across the galaxy. (Randall, 1981, p. 1)

Uniqueness of Concepts. Setting propositions in science fiction stories can be categorized according to whether they refer to concepts which exist only within the story's fictive universe, to concepts which exist within the science fiction genre, or to concepts which exist in mundane fictive discourse.

1. Novel. A Setting proposition is novel if it does not exist outside the fictive universe to which it refers. The following sentence contains novel Setting propositions:

> She considered, then excused herself, found the dispos and cleaned her stomach, bought a sobor from the vending machine and pressed the vial to her arm. (Randall, 1981, p. 5)

2. Genre-Specific. A Setting proposition is genre-specific if it refers to concepts which can be found in that story and in science fiction stories which refer to other fictive universes, but cannot be found in mundane fictive discourse. The following contains genre-specific Setting propositions (underlined):

> She queried every shipping company serving the planet...The answers came over the next planet-months: no, and no, and not since five years back and then in a different sector. (Randall, 1981, pp. 2-3)

3. Existent. A Setting proposition is existent if it refers to concepts which exist within the universe of mundane fictive discourse. The following sentence contains existent Setting propositions (underlined):

> Always arriving the barest moment too late, always just behind the jet that left, the ship that sailed, the tauship that taued the day before, carrying him with it. (Randall, 1981, p. 1)

Simultaneous Category Membership. Setting propositions belong to a level of imagery and a uniqueness of concept category simultaneously. Nine types of Setting propositions could appear in science fiction (see Figure 1), but types 4 and 5 were eliminated because of their rarity.

Figure 1: Setting Propositions

Level of Imagery	Uniqueness of Concept: novel	genre-specific	existent
literal-consistent	1	2	3
metaphor-consistent	~~4~~	~~5~~	6
literal-inconsistent	7	8	9

Setting Summary

A summary of a story's frame information describing the story's time, location, and reality assumptions, without teaching story-specific vocabulary, was constructed. This summary, read prior to reading the story, provided readers with a general overview of the constraints and default information suggested by the story's Setting, allowing investigation of whether the summary helped readers to comprehend the story.

Naive and Sophisticated Readers

If genre-specific schemata are formed as a function of frequency and utility (Rumelhart & Ortony, 1977), then Sophisticated readers, i.e., those both experienced and successful at reading a particular genre, could be expected to have a genre-specific schema. A Naive reader would be unable to use the genre's conventions as an aid to processing and comprehension. Naive and Sophisticated readers were identified by means of the Science Fiction Knowledge Test, a specially-constructed science fiction test. All subjects were successful adult readers.

Measures of Comprehension

Two dependent measures, comprehension of the Causal Event Chain and of the story's Setting information, were measured by specially-constructed comprehension tests. The Causal Chain Test measured subjects' comprehension of what happened in the story and what caused these events to occur. The Setting Test provided information about which categories of Type of Imagery and Uniqueness of Concept SETTING propositions were most difficult for subjects.

Method

The Subjects

The subjects were 36 Sophisticated and 36 Naive science fiction readers ranging in age from 16 to 54 and ranging in educational level from high school seniors to those holding the doctoral degree. There were 55 males and 17 females. Sophisticated science readers were selected from a science fiction club at Princeton University, miscellaneous other universities, a public high school, and professional adults with advanced degrees. Naive subjects were similar in background to the Sophisticated science fiction readers.

Subjects were considered Naive science fiction readers if they obtained a score between 1 and 8, inclusive, or Sophisticated if they obtained a score between 14 and 21, inclusive, on The Science Fiction Knowledge Test. Data from subjects in the initial pool whose scores ranged from 9 to 13, inclusive, were eliminated from consideration. Cut-offs were established during feasibility studies.

Materials

The materials consisted of the 21-item Science Fiction Knowledge Test; an adapted version of Marta Randall's story, Secret Rider (1981); the Setting Summary; the 16-item Causal Chain Test, and the 35-item Setting Test.

The Science Fiction Knowledge Test. The Science Fiction Knowledge Test was constructed by: submitting a list of 50 genre-specific terms and concepts with suggested definitions to two science fiction experts--Dr. James Gunn and Dr. Stanley Schmidt--who provided information about accuracy, requesting that adults who do not read science fiction provide a definition for each item that they thought would make sense within the context of science fiction, using the incorrect responses thus obtained to construct a 24-item test which was subjected to feasibility testing, presenting a revised test to two different science fiction experts--Samuel R. Delany and Marta Randall (author of the story used in the study and 1983 President of the Science Fiction Writers Association of America)--who agreed that Sophisticated science fiction readers could be expected to be familiar with the items used.

Design of the Study

The study was organized in the following manner:

Figure 2

Independent Variables		Dependent Variables	
Sophisticated Science Fiction Readers	Setting Summary	Causal Chain Test	Setting Test
Naive Science Fiction Readers	Setting Summary	Causal Chain Test	Setting Test
Sophisticated Science Fiction Readers		Causal Chain Test	Setting Test
Naive Science Fiction Readers		Causal Chain Test	Setting Test

The Experimental Story. Secret Rider (Randall, 1976), a science fiction story rich in Setting details, namely, was chosen. For the study, Randall shortened the story in a manner that both preserved the Causal Chain and retained enough Setting information in the desired categories to test the study's hypotheses. The story used in the study is Randall, 1981.

The Setting Summary. Setting propositions that were hypothesized to facilitate readers' comprehension of the Causal Chain were selected for inclusion in the Setting Summary. The Setting Summary did not afford the reader the meaning of the novel or genre-specific vocabulary of the story.

The Causal Chain Test. Events and sub-events of the story were listed. Causal inferences were derived from this Event Chain (Trabasso, Secco, & van den Broek, in press; Warren, Nicholas, & Trabasso, 1979).

The Causal Chain Test is a 16 question multiple-choice test where the question stem, completed by the correct choice, creates a correct causal inference. Incorrect choices were created by generating answers which combine with the question stem to form one of two statement types: (a) incorrect causal inferences, i.e., statements which consist of two true events (or paraphrases of such events) linked by an inappropriate causal connector, and (b) false causal statements, i.e., statements which consist of a true event linked by a causal connector to an event for which no information suggesting its validity appears in the story.

The above causal statements are similar to the recognition statements used by Thorndyke (1975).

The Setting Test. The Setting Test was constructed by listing Setting propositions of the story and generating questions that test comprehension of those propositions. The Setting Test is a multiple-choice test where the question stem, completed by the correct choice, creates a true descriptive statement, i.e., a statement which describes general or event-specific story information. Such descriptive statements are either stated literally in the text, or they are authorized inferences (Clark, 1977).

Incorrect choices form one of three types of statements: (a) an incorrect filler statement, i.e., a true descriptive statement from the story with a detail contradicting that which was specified in the story, (b) an incorrect interpretation statement, i.e., a statement based on a literal statement in the story, but which is an incorrect interpretation of that statement, and (c) an incorrectly-linked statement, i.e., one which combines information from one part of the story with information contained in another part of the story to form a statement which is not justified by the text.

Procedures

Subjects were told that the investigator was interested in studying how well people with and without substantial experience reading science fiction understand science fiction.

Subjects completed the experimental materials in one untimed sitting which took between 75 and 90 minutes, as follows. First, the Science Fiction Knowledge Test was administered and removed. Then, the experimental story was read and removed. Next, the Causal Chain Test was administered and removed. Finally, the Setting Test was administered.

The Setting Summary was randomly presented to approximately half of the sample, that is, 16 out of 36 Naive Readers and 17 out of 36 Sophisticated readers. The Setting Summary was presented to readers with the story. Subjects were unaware of the two conditions.

FINDINGS OF THE STUDY

Causal Chain and Setting Scores

Table 1 reports the means and standard deviations for the Causal Chain Test, which measured comprehension of the Causal Chain of the experimental story, and for the Setting Test, which measured comprehension of the story's Setting propositions.

Table 2 indicates that there was a significant difference (F = 33.34, df = 1) between the means of the Setting scores as a function of level of sophistication, with Sophisticated readers obtaining the higher mean. Similarly, Table 3 indicates that there was a significant difference (F= 15.29, df = 1) between the means of Causal Chain scores as a function of level of sophistication, with Sophisticated subjects obtaining the higher mean.

Table 2 also indicates that there was no significant difference (F = .51, df = 1) between the means of the Setting scores as a function of summary condition. Similarly, Table 3 indicates that there was no significant difference (F = .03, df = 1) between the means of Causal Chain scores as a function of summary condition.

Table 2 indicates that there was no significant interaction (F = .23, df = 1) between level of sophistication and summary condition for Setting scores. Similarly, Table 3 indicates that there was no significant interaction between level of sophistication and summary condition for Causal Chain scores (F = .04, df = 1).

Uniqueness of Concept and Level of Imagery

Because proposition type 6 was the only metaphor-consistent proposition type analyzed, the relationships between metaphor-consistent and other existent types of propositions were evaluated separately. The original subscore grid was separated into two grids (see Figures 3 and 4) and the data represented by these grids were then analyzed. The subscore means for the data represented by Figure 3 are reported in Tables 4 and 5; the subscore means for the data represented by Figure 4 are reported in Table 3.

Before performing separate analyses necessary to compare recall of the different types of Setting propositions, a multi-analysis of variance, with four main effects and six interaction effects, was performed. These data are reported in Table 7. Where the effects were found to be significant, pairwise comparisons were made using Tukey's Honestly Significant Difference Test (Roscoe, 1975).

Table 7 indicates that for all subjects, there was a significant difference among uniqueness of concept, i.e., novel, genre-existent, and existent, Setting proposition subscores (F = 54.66, df = 2).

Table 7 also indicates that, for all subjects, there was a significant difference between the two level of imagery Setting subscores considered, i.e., literal-consistent and literal-inconsistent (F = 18.62, df = 1).

Table 8 indicates that for all subjects, there was a significant difference between the three level of imagery Setting subscores for existent concepts (F = 60.97, df = 2). (See Figure 4.)

Table 1

Means and Standard Deviations for the Setting Test and the Causal Chain Test by Summary Condition and Level of Sophistication

	Mean	S. D.	N
Setting Test*			
All Subjects	21.06	4.72	72
Without Setting Summary	21.36	4.67	39
With Setting Summary	20.70	4.82	33
Naive	18.39	4.33	36
Sophisticated	23.72	3.43	36
Causal Chain Test**			
All Subjects	12.74	2.64	72
Without Setting Summary	12.69	2.80	39
With Setting Summary	12.79	2.48	33
Naive	11.61	2.83	36
Sophisticated	13.86	1.88	36

* The Setting Test had 35 questions.

** The Causal Chain Test had 16 questions.

Means of uniqueness of concept Setting subscores for Naive subjects and for Sophisticated subjects were tested separately. Tukey tests indicated that there was a significant difference between the mean of genre-specific subscores (3.29) and the means of novel and existent subscores (1.99 and 2.03, respectively) for Naive subjects; for Sophisticated subjects, there was a significant difference between the mean of genre specific subscores (3.88), and the means of novel and existent subscores (2.85 and 2.88, respectively).

Table 2

Two-Way Analysis of Variance of Setting Test Scores by Summary Condition and Level of Sophisticati

Source of Variation	Sum of Squares	df	Mean Squares	F	R^2
Between Cells	527.3	3	175.8	11.36*	.33
Summary Condition	7.8	1		.51	
Sophistication Level	515.9	1		33.34*	
Sum. Cond. by Soph. Lev.	3.6	1		.23	
Within Cells	1052.4	68			
Total	1579.8	71			

* $p < .05$

Table 3

Two-Way Analysis of Variance of Causal Chain Test Scores by Summary Condition and Level of Sophistication

Source of Variation	Sum of Squares	df	Mean Squares	F	R^2
Between Cells	91.39	3	30.5	5.12*	.18
Summary Condition	.16	1		.03	
Sophistication Level	90.98	1		15.29*	
Sum Cond. by Soph. Lev.	.26	1		.04	
Within Cells	404.59	68			
Total	495.99	71			

* $p < .05$

Table 4

Uniqueness of Concept Subscore Means for Subjects by Level of Sophistication and Summary Condition

	Novel	Genre-Specific	Existent	Obs.*
Naive	1.99	3.29	2.03	72
Sophisticated	2.85	3.88	2.88	72
Without Setting Summary	2.45	3.62	2.55	78
With Setting Summary	2.38	3.55	2.33	66

* Obs. = number of observations.

Table 5

Level of Imagery (Literal-Consistent and Literal-Inconsistent) Subscore Means by Level of Sophistication and Summary Condition

	Literal-Con.	Literal-Incon.	Obs.*
Naive	2.19	2.69	108
Sophisticated	3.01	3.39	108
Without Setting Summary	2.70	3.04	117
With Setting Summary	2.47	3.13	99

* Obs. = number of observations.

Figure 3: Literal-Consistent and Literal-Inconsistent Setting Propositions

Level of Imagery	Uniqueness of Concept: novel	genre-specific	existent
literal-consistent	1	2	3
literal-inconsistent	7	8	9

Figure 4: Existent Setting Propositions

Level of Imagery	Uniqueness of Concept: existent
literal-consistent	3
metaphor-consistent	6
literal-inconsistent	9

Table 6

Existent Level of Imagery Subscore Means by Level of Sophistication and Summary Condition

	Lit-Con.	Met.-Con.	Lit.-Incon.	Obs.#
Naive	1.69	3.78	2.36	36
Sophisticated	3.03	4.53	2.72	36
Without Setting Summary	2.51	4.13	2.59	39
With Setting Summary	2.18	4.18	2.48	33

Obs. = number of observations.

Tukey Tests indicated that there was a significant difference between the mean of genre-specific subscores (3.55), and the means of novel and existent and subscores (2.38 and 2.33, respectively) for subjects who read the Setting Summary. Similarly, Tukey Tests indicated that there was a significant difference between the mean of genre-specific subscores (3.62) and the means of novel and existent subscores (2.45 and 2.55, respectively) for subjects who did not read the Setting Summary.

Tukey Tests indicated that for Naive subjects the mean for literal-consistent subscores (2.19) was significantly different from the mean for literal-inconsistent subscores (2.69). Within the set of Naive subjects' existent subscores, Tukey Tests indicated that the mean for literal-consistent subscores (1.69), the mean for metaphor-consistent subscores (3.78), and the mean for literal-inconsistent subscores (2.36) all differed significantly from each other.

Similarly, the Tukey Test indicated that for Sophisticated subjects, the mean for literal-consistent subscores (3.01) was significantly different than the mean for literal-inconsistent subscores (3.39). Within the set of Sophisticated subjects' existent subscores, Tukey Tests indicated that the mean for metaphor-consistent subscores (4.53) was significantly different from the mean for literal-consistent subscores (3.03) and the mean for literal-inconsistent subscores (2.72).

Tukey Tests indicated that for subjects who read the Setting Summary, the mean for literal-consistent subscores (3.03) was significantly different from the mean for literal-inconsistent subscores (2.47). Within the set of existent subscores for subjects who read the Setting Summary, the mean for metaphor-consistent subscores (4.18) differed significantly from the mean for literal-consistent subscores (2.18) and literal-inconsistent subscores (4.18).

Similarly, for subjects who did not read the Setting Summary, the Tukey Test indicated that the mean for literal-consistent subscores (2.70) was significantly different from the mean for literal-inconsistent subscores (3.04). Within the set of existent subscores for subjects who did not read the Setting Summary, the mean for metaphor-consistent subscores (4.13) differed significantly from the mean for literal-consistent subscores (2.51) and the mean for literal-inconsistent subscores (2.59).

Table 7

Multi-Analysis of Variance of 3 Uniqueness of Concept Setting Subscores and 2 Level of Imagery Setting Subscores by Level of Sophistication and Setting Summary Condition

Source of Variation	Sum of Squares	df	Mean Squares	F	R z
Between Cells	220.56	14	15.75	13.57*	.31
Concept Uniqueness	126.73	2		54.59*	
Imagery Level	21.61	1		18.62*	
Sophistication Level	62.99	1		54.27*	
Summary Condition	2.12	1		1.83	
Concept by Imagery	3.64	2		1.57	
Concept by Sophistication	1.79	2		0.77	
Concept by Sum. Con.	0.55	2		0.24	
Imagery by Sophistication	0.43	1		0.37	
Imagery by Sum. Con.	1.26	1		1.09	
Soph. Level by Sum. Con.	0.02	1		.02	
Within Cells	483.99	417	1.16		
Total	704.55	431			

* $p < .05$

Table 8

Two-Way Analysis of Variance of 3 Levels of Imagery Setting Subscores for Existent Concepts by Level of Sophistication and Setting Summary Condition

Source of Variation	Sum of Squares	df	Mean Squares	F	R^2
Between Cells	187.48	9	20.83	18.00*	.44
Imagery Level	141.14	2		60.97*	
Sophistication Level	35.48	1		30.66*	
Summary Condition	1.21	1		1.04	
Imagery by Sophistication	8.76	2		3.78*	
Imagery by Sum. Con.	1.47			0.64	
Soph. Level by Sum. Con.	0.21	1		0.18	
Within Cells	328.44	206	1.16		
Total	425.93	215			

*$p < .05$

Relationship Between Causal Chain and Setting Scores

Table 9 indicates that for Naive readers, the obtained r of .28 (df = 34) did not reach the required critical level of .325 necessary to be considered significant at the .05 level. Table 9 also indicates that for Sophisticated readers, the obtained r of .40 (df = 34) is greater than the critical level necessary to be considered significant at the .05 level. Approximately 16% of the variance (r^2) was explained by this relationship.

Table 9 also reports the relationship between Causal Chain and Setting scores as a function of Summary condition. For subjects who read the Setting Summary, the obtained r of .35 (df = 31) is greater than the critical level of .349 necessary to be considered significant at the .05 level. Approximately 12% of the variance was explained by this relationship. For subjects who did not read the Setting Summary, the obtained r of .58 (df = 37) is greater than the critical level necessary to be considered significant at the .05 level. Approximately 34% of the variance was explained by this relationship.

Table 9 also reports an obtained r of -.06 (df = 14) for Naive subjects who read the Setting Summary, less than the required critical level necessary to be considered significant at the .05 level. However, for Naive subjects who did not read the Setting Summary, the obtained r of .52 (df = 18) is greater than the required critical level of .444 necessary to be considered significant at the .05 level. Approximately 27% of the variance was explained by this relationship.

Similarly, Table 9 reports an obtained r of .40 (df = 15) for Sophisticated subjects who read the Setting Summary, less than the required critical level of .482 necessary to be considered significant at the .05 level. However, for Sophisticated Subjects who did not read the Setting Summary, the obtained r

of .46 (df = 17) is greater than the required critical level of .456 necessary to be considered significant at the .05 level. Approximately 21% of the variance was explained by this relationship.

Table 9 also indicates that the relationship between Causal Chain and Setting scores across summary condition and level of sophistication can be considered significant at the .05 level, since .232 is the required critical value (r = .48, df = 70). Approximately 23% of the variance was explained by this relationship.

Table 9

Relationship Between Causal Chain and Setting Scores Across Level of Sophistication and Summary Condition and By Level of Sophistication and By Summary Condition

Group	N	R^2
All Naive Subjects	36	.28
All Sophisticated Subjects	36	.40*
All Subjects w/o Setting Summary	39	.58*
All Subjects with Setting Summary	33	.35*
Naive Subjects w/o Setting Summary	20	.52*
Naive Subjects with Setting Summary	16	-.06
Sophisticated Subjects w/o Setting Summary	19	.46*
Sophisticated Subjects with Setting Summary	17	.40
Across Summary Condition and Sophistication	72	.48*

*p < .05.

Supplementary Analyses

1. One supplementary analysis was concerned with determining the effect of being a student and/or being a Princeton University student on Causal Chain scores. A Type IV Analysis of Variance (Freund & Littell, 1981; SAS Institute, Inc., 1982) evaluating the effect of subject status, the effect of attendance at Princeton University, the effect of level of sophistication, and the effect of Setting Test score, was performed. The Type IV Analysis of Variance was chosen so that the effect of each variable could be examined after correcting for the effect of all other variables. Table 10 indicates that attendance at Princeton University was not a significant factor (F = .98, df = 1), but student status was a significant factor (F = 9.43, df = 1); the mean Causal Chain score for subjects who were students was 13.20, while the mean Causal Chain score for subjects who were not students was 11.13.

2. The second supplementary analysis was concerned with determining the effect of being a student and/or being a Princeton University student on Setting Test scores. A Type IV Analysis of Variance (Freund & Littell, 1981; SAS Institute, Inc., 1982) evaluating the effect of subject status, the effect of attendance at Princeton University, the effect of level of sophistication and the effect of Causal Chain

score was performed. Table 11 indicates that neither attendance at Princeton University nor student status was a significant factor in Setting Test scores.

Table 10

Multi-Analysis of Variance of the Effect of Level of Sophistication, Attendance at Princeton University, Student Status, and Setting Test Score on Causal Chain Test Scores

Source	Sum of Squares	df	Mean Squares	F	R^2
Between Cells	178.774	4	44.694	9.44*	.36
Within Cells	317.212	67	4.735		
Total	495.986	71			
Level of Soph.	26.765	1		5.65*	
Princeton Status	4.633	1		.98	
Student Status	44.634	1		9.43*	
Setting Test	29.726	1		6.28*	

* $p < .05$

Table 11

Multi-Analysis of Variance of the Effect of Level of Sophistication, Attendance at Princeton University, Student Status, and Causal Chain Test Score on Setting Test Scores

Source	Sum of Squares	df	Mean Squares	F	R^2
Between Cells	622.06	4	155.51	10.88	.394
Within Cells	957.72	67	14.29		
Total	1579.78	71			
Level of Soph.	180.52	1		12.63	
Princeton Status	1.49	1		.10	
Student Status	.002	1		.00	
Causal Chain Test	89.75	1		6.28	

* $p < .05$

Summary of the Results

The study indicated that level of sophistication had an effect on both Causal Chain and Setting comprehension scores. Summary condition, however, did not demonstrate any significant effect on readers' scores on either the Causal Chain or the Setting tests. There was no interaction between summary condition and level of sophistication.

The analyses of Setting Test subtest scores indicated that:

1. For all subjects, genre-specific Setting subscores were significantly higher than novel and existent subscores.

2. For all subjects, the mean for literal-inconsistent Setting subscores across uniqueness of concept categories was significantly higher than the mean for literal-consistent Setting subscores across uniqueness of concept categories.

3. For Sophisticated subjects, those who read the Setting Summary, and those who did not read the Setting Summary, the mean for metaphor-consistent existent subscores was significantly higher the mean for literal-consistent and literal-inconsistent existent subscores.

4. For Naive subjects, the means for literal-consistent, metaphor-consistent, and literal-inconsistent existent subscores each differed significantly from the other two means; the metaphor-consistent mean was the highest, the literal-inconsistent mean was the next highest, and the literal-consistent mean was the lowest.

5. There was no interaction between uniqueness of concept and level of sophistication.

For all subjects, there was a weak relationship between the Causal Chain Test and the Setting Test; about 23% of the variance was explained by this relationship.

The relationship between the Causal Chain Test and the Setting Test was significant for the total group of Sophisticated subjects (r = .40) but not significant for the total group of Naive subjects. Within the group of Naive subjects, the correlation between the Causal Chain Test and the Setting Test for those who did not read the Setting Summary was significant (r = .58), while the correlation betwen the Causal Chain Test and the Setting Test for those who did read the Setting Summary was not significant.

The relationship between the Causal Chain Test and the Setting Test was significant for all subjects, but it was stronger (r = .58) for Subjects who did not read the Setting Summary than for subjects who did read the Setting Summary (r = .35).

Supplementary analyses indicated that attendance at Princeton University did not have a significant effect on Causal Chain scores, but that student status in general did have a significant effect, with subjects who were students obtaining higher Causal Chain scores. Neither attendance at Princeton University nor student status in general had a significant effect on Setting Test scores.

CONCLUSIONS

Naive and Sophisticated Readers

Naive and Sophisticated readers of science fiction differed in their ability to recall the experimental story, with Sophisticated readers recalling more Causal Inferences within the Causal Chain and more Setting propositions which were related to the Causal Chain. Specifically:

1. Subjects classified as Naive obtained significantly lower scores on both the Causal Chain Test and the Setting Test than did Sophisticated readers. Background knowledge did predict recall of Causal Chain and Setting propositions of the experimental story.

2. For Setting Test scores, not only was the mean for Naive readers (18.39) significantly lower than was the mean for Sophisticated readers (23.72), but the standard deviation was greater for Naive readers (4.33) than for Sophisticated readers (3.43). Naive readers' scores ranged from 10 to 28, while Sophisticated readers' scores ranged from 15 to 29. In a multiple-choice recall condition, Naive readers did not recall the Setting information of the experimental story as well as did Sophisticated readers.

3. For Causal Chain scores, the mean for Naive readers (11.61) was significantly lower than the mean for Sophisticated readers (13.86), and the standard deviation was greater for Naive readers (2.83) than for Sophisticated readers (1.88). Naive readers' scores ranged from 2 to 15, while Sophisticated readers' scores ranged from 9 to 16. It appears that those Naive readers with high scores were able to use a more general story schema to comprehend the Causal Chain of the experimental story. The experimental story was apparently so confusing to other Naive readers that their scores were less than if they had answered at random. In a multiple-choice recall condition, Naive readers did not recall the Causal Chain of the experimental story as well as did Sophisticated readers.

4. Naive readers' Causal Chain Test results differed from those of Sophisticated readers not only in the scores obtained, but in specific questions which were answered correctly or incorrectly. Although no Causal Chain Test question was answered correctly by more Naive than Sophisticated subjects, 3 questions were answered correctly by the same number of Naive and Sophisticated readers. Similarly, 2 questions were answered correctly by only one more Sophisticated than Naive reader.

Of particular interest are the differing results for 5 questions which entailed understanding reality assumptions of the story. For example, one of these questions required the reader to construct the following Causal Inference:

John left Terra to search for a way to overcome his illness.

This inference entails understanding that there was no escaping bio-time, a genre-specific science fiction concept. Therefore, for John to live, he had to leave Earth (Terra), where there was no known cure, and search for a cure elsewhere. None of the subsequent events of the story make any sense without understanding this. The correct inference is not confirmed by explicit information until the end of the story. Nevertheless, it is the reason the protagonist searches for John after a cure is discovered on Terra. Questions missed by a large number of subjects, especially a large number of Naive subjects, entailed understanding Setting information which made story events possible.

5. Although Sophisticated readers were more successful as a group than were Naive readers, some Naive readers' Causal Chain scores surpassed the scores of some Sophisticated readers. Some Naive subjects did not have difficulty constructing the necessary Causal Inferences. Of the 36 Naive subjects, 10 obtained Causal Chain Test scores of 14 or 15; 26 Sophisticated readers obtained scores of 14, 15, or 16. However, Naive subjects with high Causal Chain scores did not obtain Setting Test scores equivalent to scores of their Sophisticated counterparts. Only one Naive subject who obtained a high Causal Chain Test score obtained a Setting Test score over 25, and three of the Naive subjects who obtained high Causal Chain scores obtained Setting Test scores of 11, 15, and 19, respectively. In

contrast, 13 Sophisticated subjects who obtained high scores on the Causal Chain Test scored 25 or above on the Setting Test, and none obtained scores of lower than 20.

This finding supports assumption that a schema more general than a science fiction one was used successfully to encode, comprehend, and recall the experimental story's Causal Chain, while it does not appear that a more general story schema enabled Naive subjects to recall the Setting propositions equally well. Naive subjects whose Causal Chain scores were high may have attended to the story's Causal Chain at the expense of attending to the Setting.

Setting Summary

The literature on the use of summaries to facilitate and measure reading comprehension is incomplete. Summary writing has been used as a measure of comprehension (Kintsch, Mandel, & Kozminsky, 1977; Kintsch & van Dijk, 1978; Rumelhart, 1975; 1977). The use of summaries of expository text has been shown to be effective in learning the argument structure of a field (Reder and Anderson, 1979). The use of reader-generated summaries to measure how well readers understood the main ideas of a text (Garner, 1982) suggested that readers who construct generalizations efficiently may do so at the cost of deleting details from their written summaries and their mental representations of the text.

For the Setting Summary to have facilitated memory of the Causal Chain or the Setting propositions of the experimental story, readers must have used generalizations presented in the expository text of the Setting Summary to instantiate Setting details. Subjects did not use the Setting Summary in this way. A variety of reasons might account for this finding, including the following:

1. Differences between schemata which describe narrative and expository text have been described by Freedle and Hale (1979), Kintsch (1982), and Thorndyke (1975). Such differences may have an effect on readers' ability to use information learned through one mode of discourse to understand information encountered in another.

2. Readers may have had difficulty understanding the particular summary used in the present study.

3. The lack of orienting information about how to use the summary may have negated its effectiveness. Readers' perspective has been shown to influence what is recalled from text (e.g., Anderson & Pichert, 1978; Kozminsky, 1977).

4. Propositions high in the hierarchy of a story are best recalled (Meyer, 1975, 1977; Rumelhart, 1975, 1977). The findings of the present study are consistent with these previous findings. In the present study, the Causal Chain, as measured by the Causal Chain Test, was better recalled than were the Setting propositions, as measured by the Setting Test, by both Naive and Sophisticated readers. Neither the Setting Summary propositions nor the propositions tested by the Setting Test are high-level propositions.

Types of Setting Propositions

The present researcher hypothesized that there would be systematic differences in the recall of types of uniqueness of concept and level of imagery Setting propositions as a function the way in which each type of proposition conformed to or violated the SETTING conventions of simple stories. That there

were systematic differences between the categories provides support for the position that the propositions fall into discrete categories. But the scores obtained for the various categories are not entirely consistent with the expectations of the present researcher. In particular:

1. For uniqueness of concept Setting subscores, existent and novel subscore means were significantly lower than genre-specific subscore means for all subjects. It had been expected that the mean for novel propositions would be lower than the mean for genre-specific scores, but it had not been expected that the mean for existent subscores would be lower than the genre-specific subscore mean.

These results may be explained as follows:

a. Genre-specific propositions were easier for subjects to recall than were existent or novel propositions.

b. More genre-specific propositions were high in the story hierarchy than were novel and existent propositions.

c. Subjects regarded the answers to questions about existent propositions as "too easy" and responded to the test situation by looking for a trick.

2. For level of imagery Setting subscores, literal-inconsistent subscores were significantly higher than literal-consistent subscores; this was contrary to the expectation that readers would obtain higher scores for propositions which most closely paralleled the pattern of the simple story schema. Superior memory for novel informaton may be explained as a function of greater concentratation by readers on story details which did not fit the pattern of the simple story (Thorndyke & Yekovich, 1979). Subjects may have better recalled literal-inconsistent propositions because understanding them required more attention.

3. For existent level of imagery subscores, metaphor-consistent subscores were the highest for all types of readers. This result may be a function of the nature of metaphor. Ortony (1980) speculated that the presence of metaphors in text somehow facilitates the comprehension and recall of that text.

In summary, there was differential recall of the Setting propositions identified and tested in this study. The results suggested that both Naive and Sophisticated readers performed better on the same proposition categories, suggesting that recall of the different types of categories is more a function of the relationship between the experimental story and story structure in general than it is a function of experience with science fiction.

The Relationship Between Causal Chain Scores and Setting Test Scores

The relationship between Causal Chain and Setting Test scores for all groups of readers varied considerably (see Table 9). The strongest relationship was for the 39 subjects who did not read the Setting Summary (r = .58), followed by the correlation for all subjects across summary condition and level of sophistication (r = .48). For each comparision of groups with and without the Setting Summary, the correlation between Causal Chain scores and Setting Scores was nigher for groups which did not read the Setting Summary, suggesting that the Setting Summary condition, while not producing any significant

differences in Analysis of Variance tests performed, did disrupt the correlation between the two sets of scores.

This result could be fully explained only with further experimentation. It is possible that subjects used the Setting Summary differently; i.e., some may have used it to help them instantiate story-specific information, while others used it to allow them to understand the events of the story even though they did not instantiate many story-specific Setting details.

Of all groups, the correlation between Causal Chain and Setting Scores was lowest (and not significant) for the entire group of Naive subjects and for the group of Naive subjects who read the Setting Summary. This result suggests that it is possible for subjects to have directed their attention to the Causal Chain of the story, while not instantiating the Setting propositions. Such a result is consistent with the hypothesis that a general story schema allowed some Naive subjects to comprehend the Causal Chain of the story but did not help them recall Setting propositions.

The Testing Methodologies

Previous story-schema research has focused on stories varying in length from 2 sentences (Rumelhart, 1975) to about 250 words (Thorndyke, 1975). Stories written to conform to story-grammars are not "naturally occurring." That is, the stories were constructed so that each proposition could be systematically assigned to the constituent structure (Rumelhart, 1980). Black and Wilensky (1979) called for research which goes beyond studying the restricted text represented by previous story-grammar research. Research with longer and more complicated prose is necessary if a model of how adult readers understand naturally-occurring prose is to be developed.

Story grammar analysis may be less useful for long stories or multiple-protagonist stories; the Event Chain Analysis might allow researchers to explore the understanding of more complex stories (Warren, Nicholas, & Trabasso, 1979). The present study investigated readers' comprehension of a story of approximately 7600 words. The story was adapted for the purposes of the present research, but no attempt was made to constrain individual story propositions to fit a formal grammar. The story was shortened first; then events and sub-events within the story were identified.

Similarly, previous story-schema research has not systematically explored the structure of story propositions within the macro-structure SETTING. Stein and Glenn (1979) differentiated between major and minor Settings; however, this differentiation was on the basis of the place of Setting propositions in the story grammar hierarchy, rather than by an analysis of how propositions are constructed on a dimension such as uniqueness of concept or level of imagery. Although the categories of novel and literal-inconsistent Setting propositions appear to be unique to science fiction, the other categories explored in the present study may present differential processing demands in other genres.

The present investigation employed methodologies to identify the Causal Chain and to classify Setting propositions in order to study a naturally-occurring story, thus contributing a powerful tool to the study of text comprehension.

IMPLICATIONS

Among the implications of the present study are the following:

1. Different story structures may present different cognitive demands. The importance of various story constituents, such as SETTING, may vary from genre to genre. Science fiction requires readers to construct reality assumptions from the author-supplied information, rather than from experiences and knowledge.

2. Readers are unlikely to recall Setting propositions as well as events on a story's Causal Chain (Meyer, 1975, 1977; Rumelhart, 1975, 1977), but readers must be able to use the Setting of a story to establish a frame within which to view events (Kintsch, 1977; Kintsch & Kozminsky, 1977). Readers who cannot use the text of a story to help them imagine the physical, social, or temporal reality of a story may have difficulty comprehending its major events. Something alien about the Setting of a story may interfere with students' comprehension not only in science fiction, but in historical novels, stories set in different societies, or stories set within different sub-cultures of their own society, especially if much of the literature they read is set within contemporary society, possibly generating the expectation that assumptions about the real-world apply to all literature.

3. Readers experienced with a genre of literature may better understand the events and the background information of a story within that genre than do readers inexperienced with the genre.

4. Some Naive readers were apparently able to use a more general story schema to overcome the novel demands of the science fiction story, especially when it came to remembering the Causal Chain. These Naive readers possessed strategies which helped them deal with text which was not entirely comprehensible. Collins and Smith (1980) stated that such strategies include ignoring the obstacle and continuing to read, suspending judgement, forming a tentative hypothesis, re-reading current and/or prior context, and consulting an expert. Teachers should examine classroom literature for similarity to genres with which their students are familiar; new genres may present the opportunity to introduce students to the strategies Collins and Smith (1980) described.

5. The present study investigated the relationship between understanding the Setting and understanding the Causal Chain of a science fiction story. Although understanding the Causal Chain was not completely dependent on the understanding of the Setting, there was a significant relationship between Causal Chain and Setting. A better understanding of a story's Setting may increase understanding of the story's events, especially if the Setting propositions describe reality assumptions which are necessary to understanding what is plausible within the story's fictive universe. This does not apply only to science fiction. The further removed from a reader's real-world or previous reading experience is a story, the more alien is the story's Setting. Literature translated from another language, and thus intended for an audience familiar with its Setting, may pose particular difficulties for students; one object, one landscape, or even the name of a town or a river may evoke an entire set of expectations about possible and plausible actions for some readers which it may be necessary to explain to others.

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